Atmospheric Infrared Sounder/Advance Microwave Sounding Unit (AIRS/AMSU)

Geopotential Height Description

1. Intent of This Document

1a) This document is intended for users who wish to compare satellite derived observations with climate model outputs in the context of the CMIP5/CMIP6/IPCC historical experiments. It summarizes essential information needed for comparing this dataset to climate model outputs. Users are expected to consult with the enlisted references and links for more information in satellite derived Earth system observational data.

This NASA dataset is provided to increase the user friendliness of the Atmospheric Infrared Sounder (AIRS) product for the model and model analysis communities [1][2]. Since one AIRS global gridded product file comprises many variables with daily to monthly temporal coverage, a dataset with variables of a single standard name covering a long period of time will be convenient for the model communities. The data used to make this dataset was obtained from the monthly AIRS product with short name AIRX3STM [3][4] at Goddard Earth Sciences (GES) Data and Information Services Center (DISC). This dataset is created by first sub-setting the variable (here geopotential height, its number of observations and standard deviations) from the AIRS monthly product and then aggregating them in one or several files with whole mission period coverage. We provide this dataset in OPeNDAP service. The data format can be converted to netCDF format while downloading data using the service. Users can easily get one observation data for the entire mission or a subset for the period and spatial extent of interest.

Dataset OPeNDAP form links appearing on the ESGF are in the form of
https://acdisc.gesdisc.eosdis.nasa.gov/opendap/ncml/ESGF/zg_mon_AIRX3STM-006_BE_gn_YYYY.ncml.html,
where 'YYYY' is replaced by the 4-digit year of aggregation for the dataset.

1b) For questions on this dataset, contact GES DISC
gsfc-help-disc@list.nasa.gov

2. Data Field Description

The main data fields are the geopotential height retrieved from AIRS monthly product AIRX3STM, along with the number of observations and standard deviations in the ascending and descending grids [3][4].

CF variable name, units:	geopotential_height, m.
Spatial resolution:	There are 24 vertical levels from 1000hPa to 1hPa. The longitude and latitude resolution is 1 degree by 1 degree.
Temporal resolution and extent:	This data product is a regularly gridded, monthly averaged geopotential height measured by AIRS between September 2002 and September 2016.
Coverage:	Global.

The fields as contained in the OPeNDAP form are:

GPHeight_A: geopotential height in ascending node
GPHeight_A_sdev: standard deviation of geopotential height in ascending node
GPHeight_A_ct: observation number of geopotential height in ascending node
GPHeight_D: geopotential height in descending node
GPHeight_D_sdev: standard deviation of geopotential height in descending node
GPHeight_D_ct: observation number of geopotential height in descending node
time: time in days since January 1, 2002
time_bnds: lower and upper bounds of the time coordinates in the same unit
Latitude: latitude at grid center
lat_bnds: north and south bounds of the latitude coordinates in the same unit
Longitude: longitude at grid center
lon_bnds: west and east bounds of the longitude coordinates in the same unit
StdPressureLev: air pressure levels in hPa

3. Use OPeNDAP to Obtain Data

The AIRS variables are aggregated in an OPeNDAP server. OPeNDAP is an acronym for "Open-source Project for a Network Data Access Protocol" [5].

Instead of the traditional "List of files" or a wget script, we provide a link to an OPeNDAP form to fulfill the same functionalities. The OPeNDAP form provides a convenient way for users to remotely browse, analyze, subset, and download data of interest. Users are expected to register here https://urs.earthdata.nasa.gov/home to gain access to NASA Earth science data. Follow instructions here

https://wiki.earthdata.nasa.gov/display/EL/How+To+Register+For+an+EarthData+Login+Profile

to register. You may need the account to remotely download data. Some servers may require Earthdata login upon accessing the OPeNDAP links, so have the account information ready.

For AIRS 3-dimensional variables we provide data aggregations on a yearly basis to support OPeNDAP server performance. The 4-digit number before an aggregation file extension (.ncml) in the server indicates the year of the data in the particular aggregation. Should users desire a single file over multiple years, there are off-the-shelf tools to further manipulate the data downloaded from the OPeNDAP server. For example, NCO's file concatenator *ncrcat* can be used to concatenate (or aggregate) multiple netCDF files. We aggregation data over all years of availability for 2-dimensional variables [6].

On top of the OPeNDAP form there are several tabs for "Actions" such as "Get as ASCII", "Get as NetCDF 3", "Get as NetCDF 4", etc. Without checking (selecting) any of the "Variables" and specifying an index range in the format such as "4:11" in the box after a checked variable, clicking on these tabs will download the entire aggregated data with all variables in the format specified. For obvious reasons it will take some time for the OPeNDAP server to fulfill this type of request. Checking variables and clicking one of these tabs will download selected entire variables. If checking variables along with index ranges, the server will subset the variables in the specified range. The index range is specified in the form of [starting index:stride:ending index] inclusive. An index stride of 1 can be skipped in the specification.

An alternative approach, instead of using these netCDF subset/download functions in server, some DAP-compliant netCDF clients, such as ncdump, nccopy, NCO's ncks, etc. can work with the "Data URL" field to remotely download data. Please refer to these tools for more information. The "Data URL" can also be used in a number of DAP-compliant visualizers, such as Panoply, IDV, GrADS, Ferret, etc., to remotely visualize and analyze data without downloads.

4. Some Considerations for Model-Observation Comparisons

AIRS observes most areas twice per day in ascending node and descending node, which are listed as two separate variables in the dataset. Users may average them to obtain the monthly value. AIRS data grid represents a 1 degree by 1 degree cell/box with center at half degree point, whereas a grid in models is the actual grid point. Here, AIRS dataset latitude grids are ordered from +89.5 (89.5N) to -89.5 (89.5S). The longitude grids are from -179.5 (179.5W) to +179.5 (179.5E). However, models usually order the latitude from -90 (90S) to + 90 (90N) and longitude from 0 to 360 degrees.

5. Data Origin, Algorithm, Validation and Uncertainty estimates, and Instrument Overview

For the data origin and algorithm, please refer to AIRS user guide [3][7], Susskind et al. (2003, 2014) [8][9]. For data validation and uncertainty estimates, refer to AIRS performance and test report [10]. References Aumann et al. (2003) [11] and Parkinson et al. (2003) [12] contain the instrument overview. For AIRS variables in ESGF published by JPL, users may refer to Tian et al. (2019) [13].

6. References

[1] AIRS Homepage

[2] AIRS Documentation Page

[3] AIRS V6 L3 Product User Guide

[4] AIRS Science Team, 2013: AIRS/Aqua L3 Monthly Standard Physical Retrieval (AIRS+AMSU) 1 degree x 1 degree V006, Greenbelt, MD, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed in April 2020, https://doi.org/10.5067/Aqua/AIRS/DATA319.

[5] For OPeNDAP documentation, http://www.opendap.org/support/user-documentation

[6] Zender, C. S., 2008: Analysis of self-describing gridded geoscience data with netCDF Operators (NCO), *Environmental Modelling & Software,23*, 1338-1342, https://doi.org/10.1016/j.envsoft.2008.03.004F, http://nco.sourceforge.net/nco.html

[7] AIRS V6 L2 Product User Guide

[8] Susskind, J., C. D. Barnet, and J. M. Blaisdell, 2003: Retrieval of atmospheric and surface parameters from AIRS/AMSU/HSB data in the presence of clouds. *IEEE Trans. Geosci. Remote Sens.*, **41**, 390–409, https://doi.org/10.1109/TGRS.2002.808236.

[9] Susskind, J., M. Blaisdell, and L. Iredell, 2014: Improved methodology for surface and atmospheric soundings, error estimates, and quality control procedures: the atmospheric infrared

sounder science team version-6 retrieval algorithm. *J. Appl. Rem. Sens.*, **1**, https://doi.org/10.1117/1.JRS.8.084994.

[10] AIRS V6 L2 Performance and Test Report

[11] Aumann, H. H., and Coauthors, 2003: AIRS/AMSU/HSB on the Aqua mission: Design, science objectives, data products, and processing systems. *IEEE Trans. Geosci. Remote Sens.*, **41**, 253-264, https://doi.org/10.1109/TGRS.2002.808356.

[12] Parkinson, C. L., 2003: Aqua: An Earth-observing satellite mission to examine water and other climate variables. *IEEE Transactions on Geoscience and Remote Sensing*, *41*(2), 173–183. https://doi.org/10.1109/tgrs.2002.808319.

[13] Tian, B., E. J. Fetzer, and E. Manning, 2019: The Atmospheric Infrared Sounder Obs4MIPs Version 2 Data Set, *Earth and Space Science*, *6,* https://doi.org/10.1029/2018EA000508.

7. Revision History

Rev 0 – May 2020